Although the authors conclude that MNA-SF scoring is more consistent than MUST with BIVA, these results should be interpreted with caution. Currently, MNA-SF is not universally recognized as a reference tool and when compared with other reference methods (objective assessment by professional or nutritional assessment/anthropometry) it showed poor specificity, indicating a high risk for "overdiagnosis" [3,7].

This study paves the way for further research on the use of BIVA in the nutritional assessment of frail older adults. At the moment, the available evidences do not allow one to draw firm conclusions on the usefulness of BIVA to identify high-risk patients who could benefit from deeper evaluation of nutritional status and intensive nutritional intervention.

Finally, prospective studies with adequate sample size are needed to verify the relationship between this BIVA pattern and risk for adverse clinical outcomes.

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Re. "Fructose content in popular beverages made with and without high fructose corn syrup"

To the Editor:

Using three different nonstandard methods, the recent article by Walker et al. [1] reported that fructose comprised 60.6% ± 2.7% of the carbohydrate content of soft drinks made with high-fructose corn syrup (HFCS). Significantly, Walker et al. found that maltose levels were ≤1.8% in all samples of HFCS-sweetened beverages. Other glucose oligomers known to be present in HFCS were not tested for and thus not reported. Because their results differ so markedly from the specified (55%) and recently verified (55.6% [2]) fructose percentage in HFCS-55—the sweetener commonly used in sugar-sweetened beverages in the United States—it is worthwhile reviewing the three test methods they used and comparing them with the validated standard methods.

Background

HFCS refers to sweeteners made from corn-derived fructose and glucose. It is named by the percentage of fructose contained in the final product: The *Food Chemicals Codex* stipulates that HFCS-55 must contain a minimum of 55% fructose [3]. It is well known that HFCS also contains maltose and glucose oligomers—up to 5% in HFCS-55 [4–9]. Association of Official Analytical Chemists (AOAC) method 979.23 (saccharides in corn syrup) [10], using liquid chromatography (LC), was developed and validated 35 y ago as the standard method for measuring the specific carbohydrates in HFCS: fructose, glucose, and oligosaccharides. More recently, International Society of Beverage Technologists (ISBT) method 3.2 (saccharides in soft drinks) was developed and verified to accurately quantify these specific carbohydrates in HFCS-sweetened carbonated beverages [11].

Food Chemicals Codex monograph on HFCS [3] cites LC as the preferred method for determining the amount of fructose in HFCS, and suggests AOAC 979.23 in the *Standard Analytical Methods of the Corn Refining Industry* as a model [12]. The monograph specifies standardization of the test using sugars of known purity, including glucose, fructose, maltose, and corn syrup or maltodextrin (the latter to provide the higher glucose oligosaccharides known to be present).

Liquid chromatography

Hobbs and Krueger [13] determined that the LC method used originally [14], and through incorporation in the Walker et al. study was AOAC 977.20 (separation of sugars in honey) [15]. Although this method is useful for characterizing sugars in solutions containing glucose, fructose, and sucrose, it has not been validated for HFCS, which has no sucrose and additionally contains maltose and other glucose oligomers. Use of AOAC 977.20 to analyze HFCS in comparison to the more appropriate standard methods—such as AOAC 979.23 or ISBT 3.2—would most likely inflate the value of fructose by 4% to 5% when unidentified maltose and other oligosaccharides were incorrectly assigned during quantitation.

Gas chromatography and metabolomics

Neither gas chromatography (GC) nor metabolomics are commonly used for the analysis of carbohydrates in HFCS. Whatever the method, it must be standardized within the appropriate sample matrix to assure accuracy. The GC method used by Walker et al. was not designed to detect glucose oligosaccharides, was not validated for the carbonated beverage matrix, and the SDs reported were abnormally large (range = 3%–7%). Metabolomics is a relatively new screening technology useful for the characterization of products, but not for their quantitation. No mention was made of standardization with either method for the glucose oligomers known to be present in HFCS, nor was any apparent effort made to estimate the accuracy of recovery with known, verified spiked samples. As in the case of LC analysis [14], if these methods were not validated for

maltose and did not look for any additional oligosaccharides, the resulting fructose numbers would necessarily be questionable, as they would represent not the actual fructose levels but rather the levels of fructose in combination with these other sugars.

Validation, statistical analysis, and study design

Validation of a test method by identification and recovery of carbohydrates in a known matrix is essential to determining the accuracy and precision of the resulting analysis. This is particularly important in evaluating the present study, as two of the methods used in the paper (GC and metabolomics) are not commonly used for sweeteners and each has considerable intermethod variability. Additionally, the lack of data from known standards renders these methods even more questionable.

Walker et al. claimed the three methods were compared, but very limited descriptive data and/or results were reported, and statistical analyses were not performed. They referred to considerable variability among methods, but the figures only showed means. Overall SDs and coefficients of variation were mentioned in the text, but no other details about the variability in each method were presented.

The design of the study was not explained. It appears that laboratory and method were nested because each lab used only one of three methods to measure sugar content; therefore, laboratories and methods were not independent. It is unclear whether the three labs tested material obtained from the same beverage samples. It is also unclear how the new data were combined with the old LC data.

Summary

The abnormally high levels of fructose reported in Walker et al.'s study need to be questioned, as the methods used may have confounded fructose levels by incorrectly adding maltose and oligosaccharides values. It is surprising that the authors did not use for comparison the standard LC method that has been used worldwide for several decades for billions of measurements, and that they did not measure the full spectrum of carbohydrates known to be present in HFCS. It is not surprising that glucose oligomers were incompletely reported in their study as none of the three analytical methods they used appeared to have been validated for quantitation of these oligosaccharides. Furthermore, there were no estimates provided for the recovery, accuracy, or precision of the analyses for the sugars that were reported. It must be noted that the percent maltose reported in Supplementary Figure 1 does not include a value measured by the most commonly used method, LC. Thus, the level of glucose oligomers (including maltose) reported (~1.5%) is well below standard levels reported in the industry, including 4.7% (95% confidence interval, 4.59–4.81) in a recent analysis [2]. It is to be expected that percent fructose values would be overstated if glucose oligomers were not properly accounted for, as was the case in the study by Walker et al.

Acknowledgments and Conflicts of Interest

This letter was solely supported by ISBT, a not-for-profit scientific society dedicated to education and advancement of knowledge in the beverage industry. Methods and guidelines established by ISBT are widely used as standards and regulations by companies and governments around the world. LJH is executive director of ISBT. JSW is a consultant and advisor to the food and beverage industry in the area of nutritive sweeteners; clients have an ongoing interest in nutritive sweetener research, development, production, applications, safety, nutrition, and education. SF has no conflicts of interest to report.

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